

OBSERVATIONS ON FOOD HABITS OF SIX SPECIES OF INDIAN FROGS¹

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The analysis of the stomach contents of six species of frogs *Rana breviceps*, *Rana cyanophlyctis*, *Rana limnocharis*, *Microhyla ornata*, *Uperodon systoma* and *Rhacophorus maculatus* were done during July and August 1978. This investigation showed partial selectivity in feeding which probably is based on the ecological niche each occupies and thus provided an insight into the interactions amongst members of the six species.

INTRODUCTION

A good deal of literature is available on the food habits of anurans to demonstrate that they are some of the major predators of pests in nature. Several comprehensive papers such as that of Clarke (1974) on the genus *Bufo*, and Blackith and Speight (1974) on the genus *Rana* are available. However, most of the information is based on work on temperate species. Relatively little information is available on the species from tropical regions, especially that from India. Out of the 111 species of anurans in India (Daniel 1963), only the food habits of *Rana tigerina* (See literature review by Issac and Rege 1975) and *Bufo melanostictus* (Behura *et al.* 1971, and Rangaswamy and Channabasavanna, 1973) are known. In the course of the study of Biology of anurans from Orissa (Mohanty-Hejmadi 1977), the food habits of six species, *Rana breviceps*, *Rana cyanophlyctis*, *Rana limnocharis*, *Microhyla ornata*, *Uperodon systoma* and *Rhacophorus maculatus*, were studied.

MATERIALS AND METHODS

Study site: All the frogs were collected from an area of one square kilometer radius around the Vani Vihar campus of Utkal University, Bhubaneswar. Vani Vihar is located 25 metres above sea level at 20° 17' 55''N latitude and 85° 50' 12'' E longitude. The climate of Bhubaneswar and the surrounding area is of tropical monsoon type with dry evergreen forest, vegetation of wide variety, Shrub forests, cultivable land, ponds and ditches which are filled with floating or submerged vegetation. Collection data for the 6 species of frogs from different localities, taken during or immediately after rainfall are as follows. The data obtained is for one season in the year.

***Rana breviceps*:** These frogs were collected from three different localities only during the breeding season. The first batch was collected from a rocky area near Orissa State Housing Board near Utkal University campus at night on 22nd July, 1978. The second and third batches were collected from the bank of two semipermanent pools inside Utkal University campus at night on 23rd July, 1978.

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Rana cyanophlyctis: They were captured from three different localities. Two batches were collected at night from two semipermanent pools inside Utkal University campus on 21. VII. 1978. The third batch was collected in the morning from a temporary pool near Orissa State Housing Board on 3rd August.

Rana limnocharis: Two batches were captured at night from the bank of two semi-permanent pools located about 100 metres apart inside Utkal University campus on 11. VII. 78 and on 12. VII. 78.

Microhyla ornata: The frogs were collected from two different localities during July, 1978. The first batch was collected at night from a scrub area near P. G. Department of Botany, Utkal University on 12.VII.78. The second batch was also collected the same night from a scrub area near Orissa State Housing Board.

Uperodon systoma: Three batches of these burrowing frogs were captured at night from three different localities. The first batch was collected from a temporary pool located inside Regional Research Laboratory, adjacent to Utkal University Campus. The second and third batches were collected from two temporary pools located inside Utkal University Campus on 23.VII.78.

Rhacophorus maculatus: Two batches were collected at night from the bank of a semi-permanent pool on 12.VII.78 and again on 13.VII.78. The last batch was collected at night from a rocky area on 15.VII.78. All these areas are located inside Utkal University Campus.

All six species of frogs were captured by hand or net depending on their habits. The frogs were dissected within 4 hr. after collection. The volume of the stomach contents were measured by water displacement. The stomach contents were analysed, identified

and classified, as far as possible and preserved in 4% formalin. The number and percentage of each kind of prey item was summarized for each species of frog.

RESULTS

Rana breviceps (Schneider): A number of items were found but two food items made up a major portion of the diet (Table 1). These were adult winged termites (Isoptera) and beetles (Coleoptera). Other items were members of Hymenoptera, Dictyoptera, Orthoptera and spiders (Arachnid). In some of the stomachs pebbles and vegetation were also recovered. Thirty-two per cent of stomachs were found empty. The size range of food items varied from 2 (Coleoptera) to 12 mm (winged termite).

Rana cyanophlyctis (Schneider): Stomach content analysis revealed that their major food item was earthworm (Annelida). The second most important item was Coleoptera followed by Isoptera. Other food items consisted of members of Hymenoptera, Orthoptera, insect eggs and even tadpoles. In some of the stomachs vegetation was also recovered. Earthworms occurred as a major food item in all the three batches of these frogs (Table 1). The size range in length of food items was from 3 mm (ant) to 90 mm (earthworm).

Rana limnocharis (Weigmann): Insects belonging to Coleoptera followed by Hymenoptera were the most common food item for them. Other prey items included samples from unidentified Hymenoptera, insect appendages, arthropod larva, spider and an unidentified invertebrate. Besides these, in some of the stomachs pebbles and vegetation were also recovered.

Microhyla ornata (Dum-bib): Insects belonging to Hymenoptera, especially to family

TABLE 1

FOOD OF SIX SPECIES OF FROGS, *Rana breviceps*, *Rana cyanophlyctis*, *Rana limnocharis*, *Microhyla ornata*, *Uperodon systoma* AND *Rhacophorus maculatus* FROM BHUBANESWAR, ORISSA.

	<i>Rana breviceps</i>		<i>Rana cyanophlyctis</i>		<i>Rana limnocharis</i>		<i>Microhyla ornata</i>		<i>Uperodon systoma</i>		<i>Rhacophorus maculatus</i>	
No.	25		25		25		25		25		25	
Body length (range) in mm	31-44		27-65		21-44		18-25		53-79		43-78	
Body Mean volume in cc	35.92		42.12		32.60		21.08		64.92		47.40	
Mean stomach volume in cc	0.56		0.52		0.48		0.10		1.78		0.22	
	No.	%	Prey items	No.	%	Prey items	No.	%	Prey items	No.	%	Prey items
Isoptera (Termitidae)	90	71.2	9	13.28	1	1.92	5	4.09	360	91.32	2	28.56
Coleoptera	16	12.8	18	24.28	20	40.51	9	6.70	16	4.34	1	14.28
Hymenoptera (Formicidae)	4	3.2	2	3.34	5	13.46	106	86.57	14	3.04	1	14.28
Hymenoptera (Vespidae)	2	1.6	1	0.94	—	—	1	0.87	—	—	—	—
Unidentified Hymenoptera	—	—	—	—	1	1.92	—	—	—	—	—	—
Orthoptera (Acrididae)	1	0.8	—	—	—	—	—	—	—	—	1	14.28
Orthoptera (Gryllidae)	—	—	2	2.82	—	—	—	—	—	—	—	—
Dictyoptera	1	0.8	—	—	—	—	—	—	—	—	1	14.28
Insect appendages	—	—	—	—	15	28.85	—	—	—	—	—	—
Arthropod larvae	—	—	—	—	1	1.92	—	—	—	—	—	—
Arachnidae (Spiders)	2	1.6	—	—	1	1.93	—	—	—	—	—	—
Annelida (Earthworms)	—	—	26	37.14	—	—	—	—	—	—	—	—
Unidentified Invertebrates	—	—	—	—	1	1.93	—	—	—	—	—	—
Tadpole	—	—	1.0	1.42	—	—	—	—	—	—	—	—
Pebbles	4	4.4	—	—	4	7.68	2	1.87	6	1.29	—	—
Vegetation	5	3.6	12	17.08	2	3.84	—	—	2	0.43	1	14.28
Empty stomach	8	32	4	16	10	40	9	36	10	40	16	64
Length of food item in mm.	2-12		3-90		3-11		3-3.4		3-11		3-17	

Formicidae were the most important food of these frogs. Other food items included samples from Termitidae (non winged forms), Coleoptera and Vespidae (Hymenoptera). In some of the stomachs pebbles were also observed (Table 1).

***Uperodon systoma* (Schneider):** A number of items were found, but there were as many as 360 termites (winged forms) in 7 stomachs, indicating that termites (Isoptera) were the favourite food of *Uperodon systoma* (Table 1). Other food items included examples from Coleoptera and Hymenoptera (Formicidae). Some of the stomachs contained pebbles and vegetation.

***Rhacophorus maculatus* (Gray):** The food items of this frog include samples from termitidae (Isoptera), Coleoptera, Hymenoptera, Orthoptera and Dictyoptera. Most of the stomachs (64%) were empty indicating that it is an opportunistic feeder. The number of food items were also less. But the most common food of this species were the insects belonging to Isoptera, which ranked first. In some of the stomachs vegetation was also recovered. The length range of food item was from 3 mm (ant) to 17 mm (Orthoptera).

DISCUSSION

According to the size of frogs, *M. ornata* is the smallest and consumed food items within the narrow range of 3.0 to 3.4 mm. *Rana limnocharis* which is next in size, had a larger range in size of food items (3.4 to 11 mm), but, concentrated mostly on smaller sized Coleoptera (3-4 mm). *Rana breviceps*, a burrowing frog came next in size which consumed food items in the range of 2 to 12 mm however, concentrating mostly on larger sized termites. *Rana cyanophlyctis* is the only aquatic of the six species. Therefore, it consumed

aquatic insects and annelids. The range of food item was from 3 mm to 9 cm (earthworm). Being given to considerable movement at night it also had consumed other terrestrial insects. Earlier Mohanty-Hejmadi *et al.* (1979) have reported that this frog being both diurnal and nocturnal feeds both during day and night but the intake is higher at night.

Rhacophorus maculatus, the most mobile of the six which can sometimes be found on the 3rd floor of the buildings, did not seem to concentrate on any particular food item. A high percentage of the stomach were empty indicating that it is a highly opportunistic feeder perhaps feeding on insects that happen to be available. Although the range of food items was from 3 to 17 mm, the frog concentrated mostly on larger items. Mohanty-Hejmadi *et al.* (1979) have reported that this frog, being totally nocturnal, feeds at night.

Uperodon systoma, the spade foot frog of India, was the largest of the two burrowing frogs. The percentage of termites in their food items would indicate that it is selective for termites. One frog had eaten as many as 150 termites. The range of food item was from 3 to 11 mm concentrating mostly on 10-11 mm winged termites. It is interesting to note that these frogs are found in numbers near termittaries and the emergence of this frog coincides with the emergence of termites following heavy rains (Mohanty-Hejmadi, unpublished). Whitaker *et al.* (1977), have shown that termites were one of the most important food items for *Scaphiopus couchii*, in all three samples. They also reported that much of the bulk of food of *Scaphiopus* were large items. That burrowing frog populations usually inhabit concentrated food areas have been discussed by Emerson (1976). Our findings agree with her view. The concentration on winged termites and lack of mud supports the

view that *Uperodon* mainly feeds at the surface rather than underground. Mohanty-Hejmadi *et al.* (1979) have reported that the feeding schedule is perhaps restricted to the breeding season in this animal.

If one takes by habitat niche each frog occupies, the two burrowing ones, *R. breviceps* and *U. systoma* compete with each other as they concentrate on larger termites.

The small frogs which live under debris and stones near ponds like *M. ornata* and *R. limnocharis* consume smaller food items. However, *M. ornata* seems to concentrate on ants while *R. limnocharis* concentrates more on smaller beetles. This would indicate a partial niche separation in their feeding habits. The aquatic *R. cyanophlyctis* seemed to consume items not readily available to other frogs. However, it is a competitor of the other carnivorous aquatic fauna such as fishes. Since *R. cyanophlyctis* can move with equal facility on land, it also consumes other insects and thus its food niche overlaps to some extent that of other anurans. *R. maculatus* being a terrestrial frog, ventures into niches not accessible

to other frogs. This is reflected in its lack of food preference. The high number of empty stomach reflects that it eats less frequently than the other frogs examined. When it eats it prefers larger prey, the number being less. In contrast, *U. systoma* concentrates both on number as well as larger size. A close examination of the food habits indicate that Smith's (1950) comment on the food of *Scaphiopus bombifrons* that "large enough to be seen and small enough to be swallowed" seems to be an appropriate description of the prey the frogs choose. Availability probably is the next parameter for the food items as the habitat each of the frog was reflected in each of the frogs food habits.

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REFERENCES

- BLACKITH, M. RUTH AND SPEIGHT, M.C.D. (1974): Food and feeding habits of the frog *Rana temporaria* in Bogland Habits in the west of Ireland, *J. Zool. Lond.* 172: 67-79.
- BEHURA, B. K., DAS, P. K., MOHANTY, P. AND GHOSH, G. S. (1971): On the diet and feeding habits of the common toad, *Bufo melanostictus* Schneider. *Prakruti-Utkal Univ. J. Science*, 8: 79-86.
- CLARKE, D. RAYMOND (1974): Food habits of toads Genus *Bufo* (Amphibia; Bufonidae). *The American Midland Naturalist* 91: 140-147.
- DANIEL, J. C. (1963): Field guide to the amphibians of Western India. Part 1. *J. Bombay nat. Hist. Soc.* 60: 415-438.
- EMERSON, B. SHARON (1976): Burrowing in Frogs. *J. Morph.* 149: 437-458.
- ISAAC, S. AND REGE, M. S. (1975): Food of
- Rana tigerina* (Daud.) *J. Bombay nat. Hist. Soc.* 72: 143-157.
- MOHANTY-HEJMADI, P. (1977): The amphibian fauna of Orissa. *Prakruti-Utkal Univ. J. Science.* 11: 89-97.
- MOHANTY-HEJMADI, P., DUTTA, S. K., ACHARYA, B. K. AND KHAN, I. (1979): Observations on food habits of three species of frogs, *Rana cyanophlyctis* (Schneider), *Rhacophorus maculatus* (Gray) and *Uperodon systoma* (Schneider). *Proc. 6th Orissa Adv. Sc.*, (Ravenshaw College, Cuttack): p. 6.
- RANGASWAMY, H. R. AND CHANNABASAVANNA, G. P. (1973): Food and feeding habits of the toad, *Bufo melanostictus* Schneider (Amphibia: Bufonidae). *J. Bombay nat. Hist. Soc.* 70: 558-563.
- WHITAKER, JOHN, RUBIN, O. D. JR. AND MUNSEE, JACK R. (1977): Observations on food habits of four species of spadefoot toad, Genus *Scaphiopus* *Herpetologica* 33: 468-475.